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Improving meat cutters' work: Changes and effects following an intervention

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ABSTRACT

Meat cutters face higher risks of injury and musculoskeletal problems than most other occupational groups. The aims of this paper were to describe ergonomics changes implemented in three meat cutting plants and to evaluate effects related to ergonomics on the individual meat cutters and their work. Data was collected by interviews, observations, document studies and a questionnaire ($n = 247$), as a post intervention study. The changes implemented consisted of reducing knife work to a maximum of 6 h per day and introducing a job rotation scheme with work periods of equal length. Tasks other than traditional meat cutting were added. A competence development plan for each meat cutter and easy adjustment of workplace height were introduced. The questionnaire showed a reduction in perceived physical work load. In general, the changes were perceived positively. Figures from the company showed a positive trend for injuries and sick leave.

1. Introduction

Meat cutting work imposes increased risks for accidents and occupational diseases, e.g. due to musculoskeletal disorders (MSD) and cutting injuries (Lindbeck and Engkvist, 2008; Vogel et al., 2010). Several studies have confirmed that work related MSDs are multifaceted and have many contributing causes, also among meat cutters (Johansson et al., 2010; Karsh et al., 2001; National Research Council and The Institute of Medicine, 2001; NIOSH, 1997; Tappin et al., 2008). A combination of technical and other measures are considered more effective than one measure in controlling risk (Karsh et al., 2001). Intervention studies have confirmed that improvement effects can be seen, not only on MSD symptoms and absence, but also on profitability (Moore and Garg, 1998; Yeow and Nath Sen, 2006). When involving staff in participative improvement work, results were better, although every workplace must consider their context and their needs, tasks and employees (Caroly et al., 2007; Norman and Wells, 1998; van Eerd et al., 2010).

Hansson et al. (2009, 2010) have shown high wrist velocity and force demands, established risk factors for MSD, be present in meat cutting, both in line work and at individual tables. The knife, being the meat cutters' main and often only tool, is a source of both accidents and disorders (Blom, 2008; Fogleman et al., 1993; Szabo et al., 2001).

1.1. The industrial context

In 2007, 7411 individuals were employed in the Swedish Cattle Slaughter and Meat Cutting industry. The meat industry in Sweden has however, low profitability. Moreover, many companies have difficulties in recruiting meat cutters, although skilled meat cutters in Sweden have relatively high status and salaries in the companies. The meat industry thus increasingly chose to rely on meat cutters coming from employment agencies. In several personal communications with the CEO, Swedish Meat Industry Association (2009–2011) he expressed concern about the competitiveness of the Swedish meat industry. This is also verified by several industry stakeholders (Jordbruksverket, 2011; Wikström, 2011).

Between the years 2005–2007 the industry reported 940 injuries (666 occupational accidents with absence and 274 occupational diseases). Meat cutters account for 29% of the 1409 reported injuries. Most of the accidents were related to knife handling, mainly amongst meat cutters and slaughterers. When comparing work-related accidents and diseases per 1000 employees and self-employed in this industry to the average of all

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employees/self-employed in Sweden in 2007, the figures are 39 to 12 for occupational accidents and 6 to 2 for diseases (Blom, 2008).

To improve health and safety among meat cutters, in 2007 the Swedish Work Environment Authority (AV) made demands on the largest meat cutting companies, which had more than 3/4 of the Swedish meat cutting market, to reduce the risk of occupational accidents and work related diseases for meat cutters. The companies were to meet the requirements by December 31, 2008. The requirements were as follows (directly translated):

1. A work period shall be a maximum of 1.5 h between breaks and work using knives should be limited to 6 h per day. Break length should be adapted to the shift length (short work periods – short breaks, longer work periods – longer breaks). Production flow rate should be capped and an even work load must be ensured for the whole day.
2. Technical improvements that eliminate heavy lifting shall be implemented.
3. The temperature in the workplace must not fall below +12 °C.
4. There must be routines to deal with the problem of "hard pigs" (crystallized fat).
5. All meat cutters must be offered annual medical examinations for work-related symptoms.
6. Independent expertise must be employed to ensure that the requirements are met (The Swedish Work Environment Authority, 2007).

1.2. The interactive research programme

The Swedish meat cutting industry and union jointly contacted the authors of this paper for collaboration. This resulted in a four year interactive research and development programme with the dual purpose of reducing MSDs and accidents among Swedish meat cutters and also to improve company performance. The researchers had a pre-understanding of the industry and its culture and risks, based on in-depth interviews of staff on different levels as well as literature studies (Karltun, 2008, 2010; Karltun et al., 2011, 2008; Lindbeck and Engkvist, 2008; Vogel et al., 2010). Beyond this, Vogel had eight years of experience as a meat cutter, is a trained ergonomist and had fourteen years as an ergonomics consultant within the meat cutting business and experience from a previous research project (Hägg et al., 2007).

The present study was part of this programme. To meet the demands from the authorities, the case-company undertook a company-wide programme to develop and implement changes. The changes were intended as a radical improvement in the organization of meat cutting, both in the content of meat cutters' daily work and in their physical work load. The researchers were then offered the opportunity to evaluate the results of the programme. The other companies were not evaluated due to time and resource constraints. The case-company was considered to offer the best opportunities for evaluation.

1.3. Aim

The aim of this paper was threefold:

1. To describe the changes implemented in the case company.
2. To assess the effects on the individual meat cutter and his/her work from an ergonomics perspective. These effects included changes in perceptions of physical and mental demands, safety issues, workplace design and qualification demands.
3. To assess effects for the organization.

2. Material and methods

2.1. The company

The study was performed in one of Sweden's largest food processing companies (3000 employees), and the largest in slaughtering and meat cutting, which accounts for 60% of the Swedish meat industry. The company had been one of the few in the Swedish food industry, and to our knowledge the only in meat cutting, that prior to this study had been part of research programmes in order to achieve better working conditions for their employees (Hägg and Vogel, 2003, Hägg et al., 2007).

It had three meat cutting plants that were all included in this study, and each plant was a separate unit within the company. When the study was undertaken, one plant (B) cut beef in one department during the day and night shift. The second plant (B&P) cut both beef and pork in four departments on both day and night shifts. The third plant (P) cut pork in three departments, one of which also worked night shift.

2.2. Observations

Different aspects of the working environment, such as workplace and production layout, manual lifting, and work pace were observed and noted during the visits at each plant. Discussion and clarification of problems were made with relevant occupational categories on all levels.

2.3. Questionnaire

A questionnaire was developed, comprising of 7 background, 15 multiple-choice and 3 open questions concerning advantages, shortcomings and any comments (Wikman, 1991). Of the multiple-choice questions, three concerned attitudes to the new organization, four concerned physical and mental work load and the rest compared the old work organization with the new one regarding aspects, such as pauses, work pace, accidents and workplace design. The questions used to assess physical and mental exertion were previously used by Engkvist (Engkvist, 2006, 2010).

2.3.1. Respondents

All meat cutters (100%) present on the day that the questionnaires were distributed had the opportunity to answer the questionnaire. There was no active drop-out, i.e. all meat cutters present answered the questionnaire. Those sick, on parental leave or on vacation were thereby excluded. The number of respondents from each plant is indicated in Table 1.

Temporary meat cutters from employment agencies at the company had to be excluded due to language problems and

Table 1
Description of participants. Mean figures and range (within brackets).

Meat cutters	Beef (B)	Beef&Pork (B&P)	Pork (P)	All
No. of meat cutters	80	98	153	331
Respondents	66	70	111	247
Female respondents	0	13 (19%)	14 (13%)	27 (11%)
Age [years]	36 (22–57)	37 (20–59)	39 (20–62)	38 (20–62)
Experience as meat cutter [years]	13 (0.9–32.5)	10 (0.3–30.4)	10 (1–42)	11(0.3–42)
Height [cm]	180 (170–200)	176 (155–195)	178 (150–198)	178 (150–200)
Weight [kg]	85 (65–100)	83 (49–120)	83 (47–150)	84 (47–150)

organizational difficulties. It was estimated that the total number of temporary workers was approximately 100 persons (24% of all meat cutters at the company), distributed according to the size of the plants.

2.3.2. Questionnaire collection

The plants were visited in December 2008 (B) and June 2009 (B&P and P) respectively, three to six months after implementation. The questionnaires were distributed and collected during a break, provided and paid for by the company. There were opportunities to ask the researchers present for clarification when filling in the questionnaire.

2.3.3. Data analysis of the questionnaire

The multiple-choice questions were analysed using descriptive statistics, correlations between possible related answers and statistical tests. The descriptive assessment was performed using MSOffice Excel 2007. The statistical calculations were made using the PASW Statistics 18 (SPSS Statistics 18). Mean values were tested for statistical significance with an independent sample *t*-test at the 95% significance level. Cross tables were tested for significance with Pearson's square test.

The answers to the open questions were analysed concerning their content and themes were identified. The numbers of similar comments were counted concerning each question and each department or plant. Secondly the answers were added to an aggregated level concerning the whole company.

2.4. Interviews

All nine meat cutters' supervisors were interviewed on their roles as supervisors and the performance of the change process. The interviews were semi-structured and followed the same structure as the meat cutters' questionnaire. Notes were taken and structured in themes. Similarities and differences, pluses and minuses, were identified and categorised.

2.5. Document compilation

The company's annual reports for 2007–2011 were examined and company statistics on sick leave and on occupational injuries were compiled for the period 2007–2011.

3. Results

3.1. Observations

3.1.1. Meat cutting before change

There were some organizational and work load differences between the plants. At B&P, the beef cutting department had implemented a major change in working practices, as single table production was exchanged to a flow line with deboning in two stages to improve both work environment and production. First, 2–3 meat cutters cut the quarter carcass (~80 kg), letting chunks (~15 kg) fall down to a conveyor belt. Next, the other cutters had the chunks fall on their cutting table, in random order. This was mainly a non-lifting task. The chunks were separated and sorted into for example bone, fat and sirloin. Platforms were individually adjustable for optimal working height.

In B, meat cutting was conducted along a line, where all meat cutters performed all tasks. Quarters were cut down in two stages, but with manual and in some workplaces heavy handling. Quarters were cut hanging from a conveyor where working height was not adjustable. One heavy task was cutting off the whole loin section including the bone, approximately 20 kg, lift it with one hand and carry it a few steps from the conveyor, up (5–6 cm) on the standing platform and place the meat on the table in front of the line. The same method and weights applied to the fore shank and brisket. Platforms were difficult to adjust.

The pork cutting department of B&P consisted of three pace lines, for ham, side and shoulder. This work was fragmented into operations of less than 30 s and conducted at continuously moving conveyor belts. Work height could be adjusted and there was little lifting. A few single tables where meat cutters cut whole carcasses or large chunks were still used and many of the meat cutters had knowledge of working on the whole carcass. At single tables, manual handling and lifting weights of ~10 kg was frequent. On the night shift, where work was similar to the day shift, mainly temporary agency meat cutters worked. Moreover, there was a skinning department for manually and semi-automatically de-fattening ham, cutting and packing. Here work was faster and lifting was sparse.

At the P plant, three departments were specialized in cutting one part of the pig each; shoulder, middle part and ham, but one night shift cutting all parts. The production method was a mix of pace line and separate tables where some meat cutters biweekly worked either method. Most meat cutters worked at the pace line where working conditions were similar to the pork cutting department of B&P.

Thus work load for beef cutters were highest at the B&P plant, and beef cutters as a whole had higher work load than pork cutters.

In all plants and departments, pressurised purified air was blown into the membranes to separate the muscles before cutting.

3.2. Changes implemented

All plants experienced similar change processes in how their steering committees were set with representatives from management, trade union, safety representatives and sometimes from the local occupational health services (OHS). There were plant-specific committees and an overall company project steering committee. A large number of meetings were held until consensus was obtained. The work started in October 2008 for the plants, except for B, where the work started earlier, and where the changes were implemented in September 2008. Both B&P and P managed to implement the changes before the deadline in December 2008.

3.2.1. Rotation and enlargement

In order to reduce the knife work to a maximum of 6 h per day, a rotation scheme was introduced. Work periods of 65–75 min were organised with pauses and breaks of 15–35 min for food. The longer the work period, the longer the pause. The work stations included were those originally performed by the meat cutters. The additional tasks for rotation were mostly among the meat packers, such as skinning details at skinning machines, and packing at different vacuum packaging machines. These tasks involved handling and lifting meat details of smaller weights and with varied movement patterns. These tasks were mainly demanding low skill; others were controlling functions that were physically non-demanding. The result meant job enlargement within the department to tasks additional to meat cutting. For the individual, this meant five work periods a day, one of which was without using a knife. To manage the rotation scheme, a personal competence development plan was set up for each meat cutter. This, together with monitoring quality, was updated at least once a year.

3.2.2. Other demands

Other demands from the AV were addressed in the company's Safety Committees (SCs): A yearly medical examination was put into operation, based on the recommendations by Ohlsson et al. (1994) and performed by physiotherapists at each plant's OHS.

Temperature has been discussed for many years. It was closely monitored by the engineering department of the company, to ensure that temperature didn't fall below +12 °C and to certify that routines for crystallized fat were followed. Independent expertise in the form of local OHS was employed in all plants to ensure that the requirements were met. They reported to the company's SC.

3.3. Meat cutter population

The meat cutters employed in the three plants participated in this study, see Table 1.

Most meat cutters were men. All but two women were found in workplaces with physically less demanding handling and lifting tasks such as skinning and ham deboning.

The age distribution was fairly even but with some over-representation of younger (<32 years) cutters, and cutters around 50 years being underrepresented.

The meat cutters were in general experienced. In B all but one, in B&P all but four and in P all were fully experienced (one year according to Häkkänen et al. (2001) and Madeleine and Madsen (2009)).

3.4. Meat cutters' experiences of the changes

3.4.1. Physical and mental exertion and tiredness

In all three plants, less tiredness was experienced after the change (Table 2). The improvement in perceived physical tiredness, compared to the old way of working was significant. At P, the perceived improvement was less than at the other plants.

Those working at B rated more tiredness, both physically and mentally, than the others. Meat cutters at P were significantly less tired compared to B (Table 3).

All perceived more physical than mental tiredness.

3.4.2. Breaks

There was a considerable difference between the plants regarding perception of rest during breaks. The meat cutters of B&P (Table 2) perceived significantly better rest at breaks than the meat cutters of the two other plants.

3.4.3. Design of work stations and competence

Many meat cutters worked frequently at work stations not suited for their body height. Between 35 and 69% did this at least sometimes (Fig. 1). Here, comments were on negative stress as working in an appropriate working height was troublesome.

Table 2
Mean values for meat cutters from the different plants responding to questions of tiredness and rest periods compared to the old way of working" Mean values for ratings. Scale from 1 (much greater), to 7 (much less) where 4 is no change. Significant differences (95% level) are marked for each row by[a] [b] or[c]. Significant difference between B and P is marked[a], between B&P and P is marked[b], and between B and B&P marked by[c].

Questions	Beef (B) $n = 66$	Beef&Pork (B&P) $n = 70$	Pork (P) $n = 111$
How physically tired are you after a work shift compared to the old way of working?	4.80[a]	4.84[b]	4.23[a, b]
How mentally tired do you feel after a work shift compared to the old way of working?	4.45	4.27	4.15
How do you feel that the rest period works in the new way of working compared to the old one?	3.77[c]	2.91[c, b]	4.02[b]

Table 3
Mean values for meat cutters from the different plants responding to "How tired are you after a work shift?" Mean values for ratings. Scale: 0 (not tired at all) to 9 (totally exhausted). Significant difference (95% level) between B and P is marked[a].

Questions	Beef (B) $n = 66$	Beef&Pork (B&P) $n = 70$	Pork (P) $n = 111$
How physically tired are you after a work shift?	5.54[a]	5.04	4.62[a]
How mentally tired do you feel after a work shift?	4.77	4.63	4.11

In B, 48% did not consider it practically feasible to adjust work height due to time constraints, difficulties or no adjustment possibilities. For P this figure was 33% and for B&P 16%. (Fig. 2).

Whether rotation meant working on tasks they found difficult (Fig. 3), in all plants between 3 and 36% often or sometimes percieved difficulties in coping with their new tasks. At B, most of the meat cutters (68%) and in B&P 66% experienced no problems. Safety.

At B and at P, a large majority perceived the accident risks unchanged. In B&P 50% saw it as unchanged (Fig. 4). In the comments, the responses referred to negative stress.

3.4.4. Other effects of the changes

In total, 71–75% gave an answer to these questions. Of those who answered, most perceived their work as remaining unchanged. About 40% did not perceive any change in the use of their skill. The support and help from, and cooperation and contact with workmates showed the same figures. After the changes 50% perceived the same support and help from their supervisors as before. Variation in work was more or less the same: 29% did not perceive a change while 20% had more monotonous and 21% more varied work. On a question of meaningfulness, 40% saw no change while 21% perceived less meaning and 10% more meaningfulness in their work. Regarding freedom at work, 39% saw less freedom and 24% saw a worsening of conditions.

On the question of whether still working for the company in three years, 40% answered yes and 7% no, while 25% did not know. For 48% of them, the changes had not affected their willingness to work as a meat cutter. For 14% willingness had decreased and for 8% it had increased.

3.5. Open ended comments

In the open ended questionnaire answers (Table 4), the respondents expressed their view on their work and the changes. The

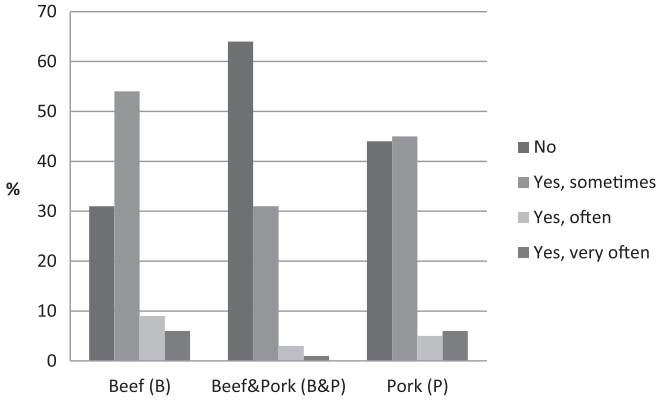

Fig. 1. Percentages of meat cutters from the different plants responding to "Do you frequently work at work stations that are not adjusted for your height". Beef (B), Beef&Pork (B&P), Pork (P) ($n = 246$).

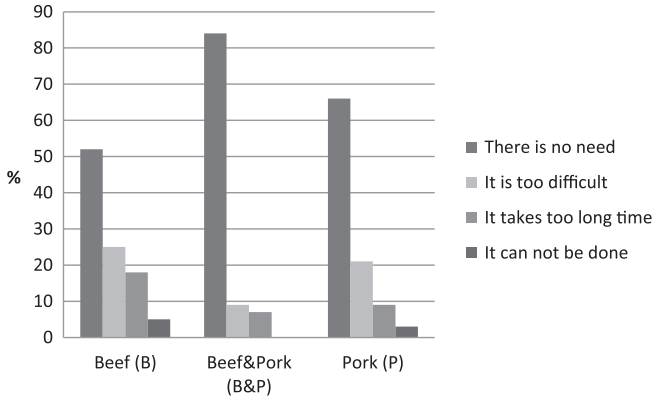

Fig. 2. Percentages of meat cutters from the different plants responding to "Why do you not change your work station height?" Beef (B), Beef&Pork (B&P), Pork (P) (n = 211).

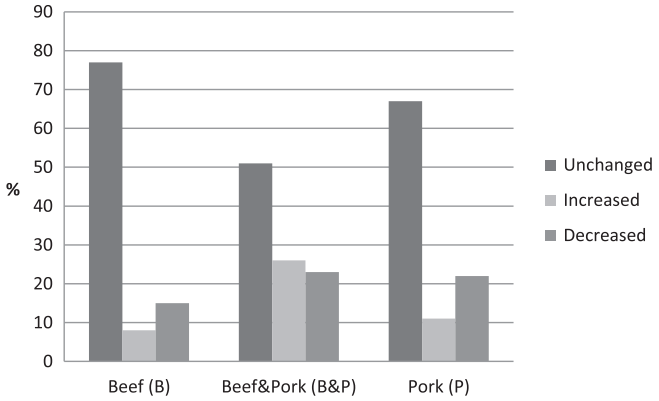

Fig. 4. Percentages of meat cutters from the different plants responding to "Do you think the accident risk is affected by the new way of working and if so, how?" Beef (B), Beef&Pork (B&P), Pork (P) (n = 245).

plant with the largest portion of employees engaged in giving their opinion about the changes was B, where 80% gave an opinion. Most of their responses were positive (54%). Almost as many, 77% gave their opinion from B&P, and from P 68% took the opportunity to give their view on the changes. There were a total of 384 opinions and suggestions, 57% of which were positive and 38% negative. A t-test showed a significantly larger number (<0.001) of positive answers from plant B. The figures for the two other plants were not significant. Opinions given were to a certain extent identical. There were many comments on the physical side of the work. Variation and diversity, as well as being less physically strenuous, were experienced as positive outcomes of the new way of working. Comments such as "You do not get as tired (physically)" (81 comments), were typical. On the negative side, most focused on the speed and pace of work, such as: "I lose my flow when I have to change position" (22 comments). As can be seen from Table 4, a number of meat cutters did not perceive any change (20 comments).

3.6. Interviews

The supervisors described the change process and the decisions as anchored in a democratic process with groups of employees and the union. They considered the rotation positive as the work load on the individuals was more even and the physical load decreased, resulting in less pain. Rotation had increased competence in the departments. For production, there was a ramp up period with some practical difficulties, eventually solved. The result was a more sustainable production where three of seven supervisors found productivity lower, but an improved yield.

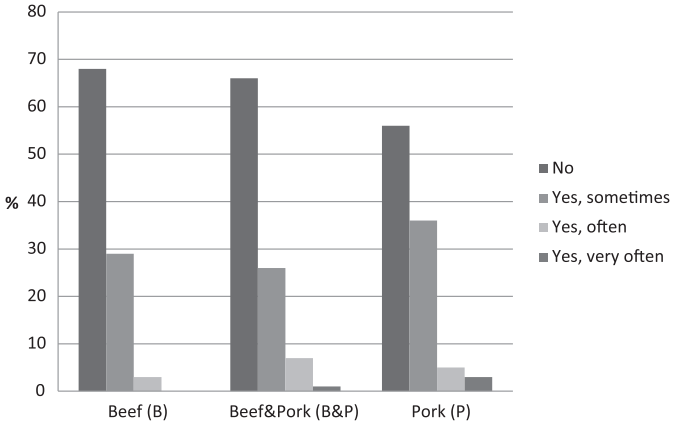

Fig. 3. Percentages of meat cutters from the different plants responding to "Does the rotation mean that you have to work in jobs that you find difficult?" Beef (B), Beef&Pork (B&P), Pork (P) (n = 246).

3.7. Document compilation

The results from Table 5 indicate an overall trend in which occupational injuries and sick leave are reduced during the years following the intervention.

4. Discussion

4.1. Material and methods

The questionnaire had a good response rate and nobody actively refrained from answering. As 68–89% took the opportunity to express a personal opinion in their own words, this indicates a profound interest in answering the questionnaire. Several studies have examined the validity of recall, there seems to be substantial forgetfulness over time, where six months seems to be the limit for accurate remembrance, although some studies found good remembrance correlated to the importance of the events and a large variation between individuals (Conway et al., 1994; Jenkins et al., 1979; Litwin and McGuigan, 1999; Must et al., 2002). The periods between change and the questionnaire were in this case less than six months.

In the questionnaire, the question "Why do you not change the height" lacked the alternative "Cannot be done", which was added by seven meat cutters. From the observations, it was considered

Table 4
Opinions of and number of comments on the changes.

	Beef (B)	Beef&Pork (B&P)	Pork (P)	All
Positive responses				
Physically positive with variation and diversity	20	32	29	81
More contact with workmates		3	2	5
Nothing is negative	3	4	16	23
Negative responses				
Nothing is positive	1	1	8	10
Loss of flow	13	6	3	22
Increased pace		7	12	19
Harder work to maintain the salary		7	4	11
It was better before…		3	1	4
Does not work as planned	1		3	4
Competitive disadvantage for the company		1	1	2
No change	1		9	10

Table 5
Data from the company's annual reports and from internal statistics, on EBIT, occupational injuries and sick leave.

	2008	2009	2010	2011
Earnings Before Interest and Taxes (EBIT) million EUR	38.1	55.1	48	
Occupational injuries/million work hours	310	289	214	249
Sick leave for meat cutters	32.3%	28.0%	28.0%	24.6%

possible to adjust height. As the alternative was stated, it can be assumed that some meat cutters found the difficulties too great. Consequently we cannot know if more meat cutters would have chosen that alternative, had it been available.

4.1.1. Limitations

To assess change in retrospect has its limitations. This is a post intervention study and lacks a baseline. Due to the realities of our research conditions this solution was the only option available as the change process and some changes had started before the research project was launched. The questions were however formulated in such a way as to facilitate comparisons before and after the changes.

4.2. Observations

4.2.1. Meat cutting

The company had several plants that functioned autonomously, which means that the company could gain from using best-practice from the different plants (O'Dell and Grayson, 1998). This means finding out what equipment and organization provides the best trade-off between good ergonomics and good profit and spreading that (Falck et al., 2010). The company planned for implementing a non-lifting method as in P&B in B. This would be according to the demands of the AV.

To encourage workers to find solutions to their own problems may be a faster way to improve conditions than relying on external expertise alone. There are many workplaces that need no further investigation, but actions regarding height adjustments and manual handling.

There was a major difference between B and B&P in how meat was cut:

In B work was conducted along a line where each meat cutter stood on platforms of poor design, sloping and very difficult to adjust the height, once it was done. The rotation demanded height adjustment, but if the meat cutter refrained from that due to difficulties, that might lead to discomfort. Work was heavy and performed according to common practice in the Swedish business. The meat cutters were however free to move, interact and speak with their workmates.

At B&P's beef cutting department, work was less physically demanding as most lifting tasks were eliminated. In that department, height adjustments were easily done on good quality platforms. Each meat cutter was however more isolated as little cooperation was needed during work. Moreover, the design of the mechanical equipment hindered personal communication. The system provided instead computerized monitoring of and feedback on each meat cutter's work.

In one plant, some meat cutters worked bi-weekly on pace line and individual tables. The company could benefit by reviewing the advantages of each method in its plant context (Johansson et al., 2010; Karltun et al., 2011).

4.2.2. Rotation and enlargement

The rotation was a means to meet the AVs demands. To further enhance the benefits, meet the negative comments and to ensure a smooth rotation, the company could include the meat packers and train those interested into meat cutters. To achieve this, the company has to put effort in the multi-skilling of all workers and have them understand the importance and potential of the rotation. With all workers multi-skilled, the company's vulnerability to absenteeism would be reduced (Eklund, 1995).

4.2.3. Changes implemented

Four of the six demands from the AV did not affect the meat cutters daily work: independent expertise, medical examinations, temperature and crystallized fat, aimed at improving working conditions in the longer term. Thus, these demands are judged to be mainly of an administrative character and thus have minor influence on the outcomes since these were addressed within one year.

The rotation meant a significant broadening in work content. From being solely a meat cutter, they were now also packers and pre-cutters. Even more, some meat cutters being specialized in cutting one part had to learn or re-learn cutting tasks. This involved broadening the tasks for supervisors as well, to manage rotation schemes, competence plans and teaching meat cutters their new tasks. Developing a schedule for the rotation that takes into account the needs of the meat cutter not to lose flow in work and maximise the effects of rotation was considered advantageous. How the changes affected the rest of the employees was not an issue for this paper. The addition of less demanding tasks in the rotation scheme, however, led to some personnel who were unable to perform meat cutting tasks being laid off.

When employees vary their tasks, move between machines and tools and change tasks with one another, risk of accidents could increase as in shift work (Wong et al., 2011). This was not viewed as a major problem by the meat cutters.

An interesting possibility may be pooling experiences (Vogel, 2008) from the different project committees, to disseminate best practice throughout the company.

The changes represented a broad view on ergonomics; not only physical changes, but a view on working conditions, which at its best will optimize human well-being and system performance (IEA, 2000).

The process being conducted in a participatory way was perceived as positive. As Busck, Knudsen & Lind argue in two articles (2010; 2011), participation contributes both to company success and quality of work environment.

4.2.4. Effects on meat cutters

The results concerning physical and mental exertion for meat cutters ($N = 247$; 89% men) were compared with a previous study where identical questions were asked at recycling centres ($N = 122$; 90% men). Workers at recycling centres showed physical exertion 4.4 and meat cutters 5.0, mental exertion at recycling centres 4.4 and meat cutters 4.4 (Engkvist, 2010). This comparison indicates that meat cutting is more physically demanding work but that the mental demands are more equal regarding those workplaces. According to Volkoff et al. (2010), employees in their fifties have problems in work under time pressure. In our study no cutter was older than 62 years old, indicating that meat cutters do not reach retirement age (65 years in Sweden) as meat cutters. Moreover, the inclusion of less physically demanding workplaces in the rotation scheme meant that these workplaces were not available as "close-to-retirement" positions as before. This was commented on by supervisors saying things like "From now on, it will not be easy to get old in this company". Given time, there are expectations in the group of supervisors, that the improved working conditions will reduce MSDs and improve the ability to work until retirement age. They claimed that when fewer are injured, the need for physically easier

tasks decreases; it's a symptom remediation system. Figures to support this were not available.

There were problems in acquiring correct working height, especially in B. The workplace platforms were heavy and difficult to move, uneven and often sloping. There was a considerable difference from B&P, where most platforms were of better quality and easy to change. Our observations thus correspond with the questionnaire results.

Moreover, a new plan for maintenance and order keeping of the work stations were to be introduced since the private workplaces disappeared with the rotation and with this, also the will to maintain your own workplace. This was commented on in the open answers as a perceived problem.

Rotation meant a more even distribution of working time and breaks and doing other tasks than before. When giving open answers, some wrote that changing tasks made them loose flow. Other answers dealt with the difficulties in changing from the safe and well known specialized job to unfamiliar tasks both in meat cutting and other tasks. The issues of flow, maintaining salary and contact with workmates provide challenging tasks for the future; how to design tomorrow's workplaces and tasks to suit young people and attract employees.

Whether it was the rotation or the knife free work period that resulted in a reduction in work load, is impossible to distinguish. The open answers in the questionnaire indicate that the knife free work period was appreciated as a means of reducing work load. It is however possible that the rotation in itself provided a variation that contributed to the perceived reduction in physical work load.

The meat cutters in P&B perceived better breaks and recovered better than before the changes. One reason for this could have been the reduced work load due to the rotation scheme and indications that the change was more thorough. Another reason might be a better design with more even work periods and breaks.

As has been obvious in the open answers of the meat cutters, they are committed to their work and want to influence their work situation.

4.2.5. Other effects of the changes

Most of those who answered the questions of other effects experienced no major change in their work.

The effects of temporary workers were not an issue for this study and thus not assessed. It can be assumed (Lloyd and James, 2008) that increasing the number of temporary workers with low understanding of Swedish will increase the number of accidents and impair both the company and the union's ability to work with health and safety issues.

Some meat cutters expressed a concern that wages would decrease. This may pose a risk of meat cutters abandoning the trade to find another living resulting in a greater dependence on temporary workers. Both these issues are vital to the companys' future.

When using Westgaard and Winkel's model (2011) exchanging rationalizations for change as in this study, we can model some possible future outcomes. The participatory method, lesser physical load, better pauses and job satisfaction may result in better health for the meat cutters. The yearly medical examination may prove a valuable instrument to assess health issues. On the other hand, we do not know the effect on the packing personnel and others.

Vink's findings (2006) add to the picture of participation as positive for both employee health and company productivity.

4.3. Interviews

The supervisors were satisfied with the change process and as a whole with its results. They commented on productivity and yield. Both contribute to profitability, but too high work pace decreases yield and quality. It seems to us that this was not clear to the supervisors. In Coutarel et al.'s study (2004) there were large improvements in working conditions by decreasing work pace to achieve better yield and quality of products.

4.4. Document compilation

Nowhere in the annual reports were the changes for meat cutters mentioned. Both occupational injuries and sick leave may have many causes, but there are indications that the changes described in this paper have contributed positively. A major negative effect on company profitability due to the changes seems unlikely. In the company's statistics on occupational injuries, there were small changes between 2007 and 2010. Occupational injuries decreased from 79 to 77 and diseases from 13 to 11.

4.5. Impact on industry

When the demands from the AV came, several representatives from the meat industry expressed a strong fear that the sustainability and competitiveness of the companies would be severely affected, both nationally and internationally (Rutegård, CEO of Swedish Meat Industry Association, personal communication 2011). In 2010, the AV extended their demands to all of the meat cutting industries. So far there is no evidence that the changes have had a great impact on their competitiveness. The company in this study as well as the other companies that the AV made demands on, made changes according to the requirements, and all of them are still in business. As working conditions for meat cutters is a problem in other countries, similar requirements may be expected there.

Further studies are needed in order to reveal the economic impact of the AV requirements on the Swedish meat cutting business.

5. Conclusions

The intervention (introducing a rotation scheme and reducing knife work to maximum 6 h per day) was regarded highly positive by a majority of the meat cutters. This work organization solution can thus be considered to be much better than the previous ones in this case.

The interventions included non knife related work, work and rest pattern, job rotation and competence development, in addition to administrative, more long term improvements. The results further indicate that it was possible to reduce the time working with a knife to 6 h per day out of an 8 h working day without significant financial losses. The rotation and knife free work however made certain complementary measures necessary:

- In order to make the rotation scheme work, the introduction of an individual competence and skill development programme for all meat cutters had to be introduced.
- There was a need for easily adjustable workplaces since each worker changed workplace during each break. The time needed for adjusting the workplace to a worker therefore had to be minimized since this procedure could be required five times a day. The technical system thus support the organizational changes wanted.
- Time should be allowed for finding appropriate rotation schemes and ramp up procedures.
- The feeling of lost flow in work should be dealt within some way and might need some further examination.

The changes meant an actual reduction in perceived physical tiredness of the meat cutters, but less change of the perception of mental tiredness.

Perceived accident risks were not particularly affected. Other major changes in work were not perceived by the meat cutters.

The process in itself was conducted in a participatory way. Many issues were addressed in the company's SCs ensuring the trade unions to be involved.

6. Relevance for industry

- A change in work content as described in this article is considered mainly positive by the workers affected.
- It is possible to reduce the time working with a knife for meat cutters, thus changing their work content, without radical setback for the company.
- Reducing the time working with a knife in most cases means reducing repetitive work load and hence decreasing risk of MSD.
- A participative change process including management and union representatives created joint support for the changes introduced.

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